1.7 Electromagnets

Learning objectives

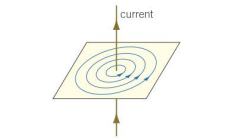
After this topic you will be able to:

- describe how to make an electromagnet
- describe how to change the strength of an electromagnet.

Permanent magnets are fun, but you can't turn them off.

The magnetic field around a wire

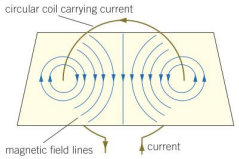
A wire with an electric current flowing through it has a magnetic field around it. You can investigate the field with a plotting compass. The field lines are circles.



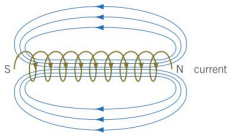
▲ The magnetic field around a wire.

Making an electromagnet

You can make a circular loop of wire and pass a current through it. The magnetic field lines at the centre of the loop are straight.



◀ The magnetic field around a loop of wire.



▲ The magnetic field around a coil of wire.

The magnetic field around a single loop isn't very strong. If you put lots of loops together to make a coil the field is much stronger. This is an **electromagnet**. The shape of the magnetic field is just like the shape of the magnetic field around a bar magnet.

You can turn an electromagnet on and off by turning the current on and off. The magnetic field is only produced when the current is flowing in the wire.

Using a core

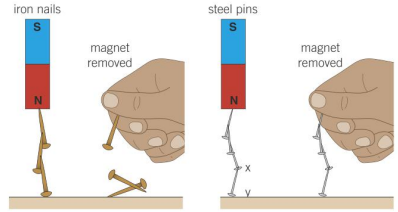
Electromagnets usually have a magnetic material in the centre of the coil, called a **core.** This makes the electromagnet much stronger. Most cores are made of iron. Iron is easy to **magnetise** but loses its magnetism easily.

Steel is hard to magnetise but keeps its magnetism. If you had a steel core in an electromagnet you could not turn the electromagnet off, because the steel would still be magnetic.

A State the type of material you can use for the core of an electromagnet.

Foul Fact

Doctors in hospitals have used electromagnets to remove steel splinters from a patient's eye.



▲ Steel stays magnetic when you remove the magnet.

How do I make an electromagnet stronger?

The strength of an electromagnet depends on:

- the number of turns, or loops, on the coil. More turns of wire will make a stronger electromagnet.
- the current flowing in the wire. More current flowing in the wire will make a stronger electromagnet.
- the type of core. Using a magnetic material in the core will make a stronger electromagnet.

B State three things that affect the strength of an electromagnet.

Permanent magnet or electromagnet?

Permanent magnets and electromagnets both have their uses. There are two main differences between permanent magnets and electromagnets.

- You can turn an electromagnet on and off.
- You can make electromagnets that are much stronger than permanent magnets.

Fantastic Fact

The strongest magnet is an electromagnet that produces a magnetic field 10 million times stronger than the Earth's magnetic field.

Key Words

electromagnet, core, magnetise

▲ The strength of an electromagnet depends on the number of turns on the coil, the current, and the core.

Summary Questions

1 Copy and complete the sentences below.

When a _____ flows in a wire it produces a _____ _____ around it. You can make an electromagnet using a _____ of wire with a _____ flowing in it. The shape of the _____ _____ around an electromagnet is the same as that around a bar magnet.

(5 marks)

2 Describe how to use a nail, a piece of wire, crocodile clips, leads, and a battery to make an electromagnet.

(2 marks)

3 Use the ideas on these pages to explain in detail why the number of coils, the current, and the type of core affect the strength of an electromagnet.

(6 marks)